WHAT IS CLAIMED IS:

1. An electromagnetic wave frequency filter, comprising:

a) an input waveguide for propagating an electromagnetic wave;

b) an output waveguide for propagating an electromagnetic wave, which is positioned so that its distance from the input waveguide at a predetermined section along its length is shorter than its distance at another section; and

c) a resonator that resonates with an electromagnetic wave having a predetermined frequency, which is located within the predetermined section between the input waveguide and the output waveguide.

2. The electromagnetic wave frequency filter according to claim 1, comprising:

multiple output waveguides; and

multiple resonators, each of which is located in a predetermined section between the input waveguide and each output waveguide and resonates with an electromagnetic wave having a predetermined frequency.

3. The electromagnetic wave frequency filter according to claim 2, wherein each of the resonators corresponding to each of the output waveguides has a different resonant frequency.

4. The electromagnetic wave frequency filter according to one of claims 1 to 3, wherein one or both of the input waveguide and the output waveguide has a bend section at an end of the predetermined section.

5. The electromagnetic wave frequency filter according to claim 4, wherein the

resonant frequency of the resonator is included in a high-transmission band of the bend section.

6. An electromagnetic wave frequency filter, comprising:

a) a two-dimensional photonic crystal having a slab-shaped body provided with a plurality of modified refractive index areas having a refractive index different from that of the body, which are periodically arranged in the body;

b) an input waveguide formed by creating a linear defect of the modified refractive index areas;

c) an output waveguide formed by creating a linear defect of the modified refractive index areas, which is positioned so that its distance from the input waveguide at a predetermined section along its length is shorter than its distance at another section; and

d) a resonator consisting of a point-like defect that resonates with an electromagnetic wave having a predetermined frequency, which is located within the predetermined section between the input waveguide and the output waveguide.

7. The electromagnetic wave frequency filter according to claim 6, wherein the point-like defect is a donor type point-like defect formed by creating a defect of the modified refractive index areas.

8. The electromagnetic wave frequency filter according to claim 6 or 7, comprising: multiple output waveguides; and

multiple resonators, each of which is located within a predetermined section between the input waveguide and each output waveguide and resonates with an electromagnetic wave having a predetermined frequency.

9. The electromagnetic wave frequency filter according to claim 8, wherein each of the resonators corresponding to each of the output waveguides has a different resonant frequency.

10. An electromagnetic wave frequency filter, comprising:

a) a two-dimensional photonic crystal having an in-plane heterostructure, which includes:

a slab-shaped body provided with two or more forbidden band regions; and

a plurality of modified refractive index areas having a refractive index different from that of the body, which are periodically arranged within each of the forbidden band regions with a cycle that is differently determined for each of the forbidden band regions;

b) an input waveguide passing through all the forbidden band regions, which is formed by creating a linear defect of the modified refractive index areas within each of the forbidden band regions;

c) an output waveguide formed by creating a linear defect of the modified refractive index areas within each of the forbidden band regions, which is positioned so that its distance from the input waveguide at a predetermined section along its length is shorter than its distance at another section; and

d) a resonator consisting of a point-like defect that resonates with an electromagnetic wave having a predetermined frequency, which is located between the input waveguide and the output waveguide within the predetermined section.

11. The electromagnetic wave frequency filter according to claim 10, wherein the

point-like defect is a donor type point-like defect formed by creating a defect of the modified refractive index areas.

12. The electromagnetic wave frequency filter according to claim 10 or 11, wherein a portion of a transmission band of the input waveguide in each forbidden band region is outside a transmission band of the input waveguide in all the other forbidden band regions located on one side of the forbidden band region concerned, whereas the same portion is included in the transmission band of the input waveguide in all the other forbidden band regions on the other side, and the resonant frequency of the resonator located within the forbidden band region concerned is included in the aforementioned portion of the transmission band.

13. The electromagnetic wave frequency filter according to claim 12, wherein, for each forbidden band region, the distance between the resonator belonging to the forbidden band region and a boundary with an adjacent forbidden band region located on said one side is determined so that a phase difference between an electromagnetic wave having frequency equal to the resonant frequency of the resonator of the forbidden band region concerned and being reflected by the resonator and an electromagnetic wave having the same frequency and being reflected by the boundary of the forbidden band region after passing by the resonator is π.

14. The electromagnetic wave frequency filter according to claim 12 or 13, wherein the point-like defect is a donor type cluster defect formed by creating three defects of three modified index areas located on a straight line.

15. The electromagnetic wave frequency filter according to one of claims 6 to 14, wherein one or both of the input waveguide and the output waveguide has a bend section at an end of the predetermined section.

16. The electromagnetic wave frequency filter according to claim 15, wherein the resonant frequency of the resonator is included in a high-transmission band of the bend section.

17. The electromagnetic wave frequency filter according to claim 16, wherein the modified index area at the bend section differs from the other modified index areas in one or more of its refractive index, cycle, shape and size.

18. The electromagnetic wave frequency filter according to one of claims 6 to 17, wherein at least one of the resonators is partly or entirely created from a material whose refractive index changes due to an external operation.

19. The electromagnetic wave frequency filter according to one of claims 1 to 18, wherein the output waveguide is provided with a reflector for reflecting the electromagnetic wave having frequency equal to the resonant frequency of the resonator, and the distance between the resonator and the reflector is determined so that a phase distance between the electromagnetic wave introduced from the resonator into the output waveguide and the electromagnetic wave reflected by the reflector is zero.

20. The electromagnetic wave frequency filter according to one of claims 1 to 18, wherein the output waveguide is provided with a reflector for reflecting the electromagnetic

wave having frequency equal to the resonant frequency of the resonator, and the distance between the resonator and the reflector is determined so that a phase distance between the electromagnetic wave reflected by the resonator and the electromagnetic wave reflected by the reflector is π.

21. The electromagnetic wave frequency filter according to claim 19 or 20, wherein the reflector consists of one of the following parts: an end of the output waveguide; a bend section formed at an end of the predetermined section; an end section formed at a position outside the predetermined section; and a boundary of an adjacent forbidden band region located on said one side.

22. The electromagnetic wave frequency filter according to one of claims 1 to 21, wherein at least one resonator radiates a portion of the electromagnetic wave resonating.